

**CIRCUIT FOR PRODUCING POTENTIALLY SEPARATED SYNCHRONISATION  
IMPULSES FROM AN ALTERNATING VOLTAGE NETWORK**

5           The present invention pertains to a circuit for producing galvanically separated synchronization impulses from an AC mains.

          Particularly in electric energy supplies, as in combinational circuit parts of low output for supplying household appliances, it is often necessary to have available, in addition to an output voltage, e.g., 9.6 V, on the secondary side of a combinational  
10   circuit part, a galvanically separated output signal that is synchronous with line voltage for synchronizing phase controls and/or clocks. The synchronizing signal, as protective low voltage, requires a secure electric separation, and the operation shall also be guaranteed without ground wire connection.

          According to the state of the art, the synchronization signal is produced on the  
15   secondary side of the combinational circuit parts from a shunting of the line voltage via ohmic resistances along with separation of the line voltage by means of protective impedances suitable for this. However, a ground wire must be connected, with which the secondary mass is to be connected and the neutral wire of the mains must be rigidly grounded.

20           An object of the present invention is to produce galvanically separated synchronization impulses with simple means and with cleaner galvanic separation.

          This object is accomplished according to the present invention with a circuit for producing galvanically separated synchronization impulses from an AC mains, in which, according to the present invention, the line voltage rectified by means of a  
25   half-wave rectifier, lies on a voltage divider of a semiconductor switch, the emitting diode of an optocoupler lies in a working branch of the switch, whereby the working

branch has, in series with the emitting diode, a drop resistor, via which a storage capacitor can be periodically charged and can be discharged via the emitting diode and at least one transistor is arranged downstream of the receiving element of the optocoupler, which transistor is fed by a voltage source that is galvanically separated  
5 from the line voltage and in whose load branch the essentially rectangular synchronization impulses are available.

A largely rectangular synchronization signal, with which different objects can be accomplished, in particular on the secondary side of combinational circuit parts, is obtained in a simple manner due to the present invention.

10 The semiconductor switch is advantageously a transistor.

In a variant, provisions are advantageously made for a voltage-limiting Zener diode to lie parallel to the storage capacitor.

Another advantageous variant is characterized in that the series connection of the drop resistor, the emitting diode and a current-limiting resistor lies in the working branch  
15 of the switch, whereby the storage capacitor lies parallel to the emitting diode-current-limiting resistor-switching junction series connection of the input transistor. Furthermore, a resistor for defining the potential may lie parallel to the emitting diode.

To prevent the penetration of high-frequency disturbances and a tampering with the synchronization signal, provisions can be advantageously made for a filter  
20 capacitor to lie parallel to a resistor of the input voltage divider.

Furthermore, it is advantageous if the transistor arranged downstream of the receiving element is a Darlington transistor.

In many cases it is recommendable if another transistor for phase reversal is

arranged downstream of the transistor, which is arranged downstream of the receiving element of the optocoupler, whereby the synchronization impulses are available at the working resistor of this transistor.

The present invention, together with other advantages, is explained in detail  
5 below based on an exemplary embodiment, which is illustrated in the drawing. In this drawing, the only figure shows a possible embodiment of a circuit according to the present invention.

As is clear from the drawing, an input line voltage  $U_N$ , e.g., 230 V, 50 Hz, via a rectifier diode D1, which represents a half-wave rectifier, lies on a base voltage divider  
10 R1/R2 of an npn transistor T1. The series connection of a drop resistor R3, the emitting diode DO of an optocoupler OKO and a current-limiting resistor R4 lies in the collector branch of the transistor T1. This series connection lies between the collector terminal of the transistor T1 and the rectified, i.e., half-wave input alternating voltage. The emitting diode DO of the optocoupler OKO is bridged over by a resistor R5, which is advantageous  
15 for defining the potential. A filter capacitor C1, which keeps high-frequency disturbances away from the base of the transistor T1, lies parallel to the resistor R2 of the voltage divider R1/R2. The connection point of the drop resistor R3 to the emitting diode DO is grounded via a storage capacitor C2, whereby a Zener diode D2, which limits the voltage at the capacitor to a certain value, e.g., 10 V, lies parallel to the storage capacitor C2.  
20 The receiving element EO of the optocoupler (OKO), generally a phototransistor, as shown here, lies via a working resistor R6 on a secondary operating voltage  $U_B$ , whereby this operating voltage may be, for example, the controlled output voltage of a combinational circuit part. In the present case, a transistor T2, which is advantageously embodied as a Darlington transistor with a working transistor R7, is arranged  
25 downstream of the receiving element EO. In some cases, it is still expedient to let

another transistor T3 with a working resistor R8 follow for phase reversal, whereby the synchronization impulses sync are available here at the collector of this transistor T3. A capacitor C3 may lie between the base emitter junction of the transistor T3 or another suitable point for damping possible switching peaks or high-frequency disturbances.

5           In the operation, the input alternating voltage  $U_N$  is switched from the base emitter junction of the input transistor T1 with a relative sharp switching threshold, as a result of which the emitting diode DO is activated in the collector branch of the transistor T1. The optocoupler is thus actively driven during the positive network half waves and a synchronization signal is transmitted in an electrically secure, separated manner. The  
10 storage capacitor C2 with its discharge resistor R4 is designed such that during the entire half wave of the line voltage, thus also during the voltage zero passage, a sufficiently large current is available for driving the optocoupler and the signals are, de facto, rectangular on the secondary side. While the resistor R4 discharges the capacitor C2, the capacitor is charged via the resistor R3. With corresponding selection of the time  
15 constants, a largely symmetrical output signal can be obtained on the secondary side, i.e., at the collector of the transistor T2 or at the collector of the transistor T3.

Instead of the input transistor T1, a semiconductor switch, which lies as exactly as possible at the zero passage, can generally be used.